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OsgVortex User Guide

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OsgVortex User Guide v0.2.1

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Chapter 1

What is OsgVortex

This chapter will give an introduction to the tool OsgVortex and describe the overall system.

Designing a real-time simulation system is a complicated and large task. OsgVortex lets you describe a simulation system containing both visual and physical objects. There are few systems that encompass both visual as well as physical objects. VEGA Prime from MultiGen Inc. is one example where they have successfully done this. Unfortunately VEGA Prime is a huge and expensive system, not suitable for academic courses, simple prototyping etc.

OsgVortex is a small middle layer between two different packages; OpenSceneGraph and Vortex and is indented to be easy and intuitive to use. OsgVortex lets the user create objects in an ASCII script file. By running the sample viewer that comes with OsgVortex the script is executed and a simulation world is created. By allowing easy changing of values in the script, prototyping of a simulation world is possible.

Vortex

Vortex from Critical Mass Labs inc. Montreal Canada is a commercial toolkit (API) for handling rigid-body dynamics. It allows the programmer to create objects that has physical properties such as mass, velocity, geometry etc. By setting up a system with objects, joints connecting object a complicated fully physical system can be created. Vortex steps through the system for each time-step and solves the dynamic problems concerning forces generated from collisions, friction as well as constraints from joints. Vortex is said to be a real-time simulation toolkit as it can solve rather large systems where the simulation time (the step time) is the same as the clock time. If the simulation time runs slower that the clock time (can happen when the system becomes too large and Vortex is unable to solve the system fast enough) the simulation will look like it is running in slow-motion. If on the other hand the simulation time is running faster than the clock-time (if Vortex solves the system faster than the step-time) the system will run to fast, like looking at an old Charlie Chaplin movie. OsgVortex handles this by running the physical simulation in a separate thread. This will allow the physical simulation to run as fast or as slow as it has to ensure a real-time simulation.

As Vortex is not free it depends on a license, which is shipped together with OsgVortex.

OpenScenegraph

OpenSceneGraph, OSG (www.openscenegraph.org) is an open source project lead by Robert Osfield, Scotland. It is an ambitious project with the goals of creating an efficient portable, Object Oriented scenegraph for handling 3D graphics.

The status of OSG at the time of writing this manual is Beta version 0.8.45. It has loaders for many common formats, among one of the most commons: 3DS, Open Flight.

The benefit of using an open source project is the code availability as well as the short cycle of updates. There is a growing community around OSG which is rather efficient to fix bugs. Another benefit is of course that there are no licenses or fees involved.

A drawback is of course that newer versions often break the users code due to the quick changes. At end of July 2002 OSG will reach version 1.0 and will probably be more stable.

Declarative scripts

To create a simulation with OsgVortex a script file has to be created. The script is parsed only during startup of the system. It is a declarative lazy parsing language. It will only read the information that is relevant to OsgVortex, i.e. it will discard any additional information in the script that OsgVortex is not interested of.

As it is declarative it can only set up a state of the system. There are no loops to define iterative executions. Although there are methods to create several objects (more later on). At the writing time the following preprocessor directives are included: #define #ifdef #else #endif

Mathematical expressions are allowed, examples of that are:

```
Size 2
Height Size*sin(PI)
```

The above example would declare two variables: `Size` and `Height`, where `Height` would have the value 2*sin(3.1416) = 0.1096

With this in mind let's install and run a sample application.

Chapter 2

Using OsgVortex

This chapter will get you started with OsgVortex, setting up the environment and run sample simulations.

OsgVortex runs under several platforms, at the writing moment only Windows and Linux are tested. As it depends on OpenSceneGraph (runs under Linux, Solaris, Irix, Windows, HPUnix) and Vortex (runs under Irix, Windows and Linux) it will always be restricted by those dependencies.

Installing

OsgVortex is accessible through the webadress: http://binky.cs.umu.se/vrlab/projects/osgVortex/ This can change in the future though. The safest way of receiving the latest version is to either contact: info@vrlab.com or andersb@cs.umu.se.

By using winzip (www.winzip.org) the files can be extracted and installed, preferably under c:\.

Setting up the environment in Windows

There are a few environment variables that can be set that will enable osgVortex to locate important files.

OSGFILEPATH is an environment variable that specifies where OSG will search for model- and image files. It is a semi-colon separated path. An example definition is:

```
DOS> set OSGFILEPATH=c:\osgVortex\primitives;c:\data\myothermodels
```

PATH is an environment variable that specifies the search path for executables and dynamic libraries in DOS. Changing this environment variable in a DOS shell only affects the shell. It won't change the rest of the Operating system settings. An example definition of PATH is:

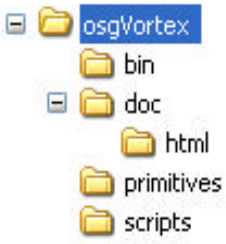
```
DOS> set PATH=c:\osgVortex\bin\;%PATH%
```

This example will make the operating system to search for executable in *c:\osgVortex\bin* as well as whatever the PATH environment variable was set to earlier (due to the %PATH% = The value of PATH).

This example will make the operating system to search for executable in *c:\osgVortex\bin* as well as whatever the PATH environment variable was set to

Directory structure

The structure of osgVortex is:



bin contains executable files and dynamic library necessary to run osgVortex.

doc contains the documentation of osgVortex, both programmer and Users Guide.

primitives contains models and textures (images) that is necessary for osgVortex.

scripts contains sample scripts for osgVortex. Scripts that you write on your own does not have to reside in the directory scripts. They can be placed anywhere.

The root directory of osgVortex also contains some important files:

setup.bat is a BAT file to setup the environment variables necessary to run osgVortex. This file can be edited to reflect the path of your installation of osgVortex.

test.bat is a BAT file that can be run to test if the installation was successful. (See Installation verification).

Installation verification

To verify that the installation of osgVortex was successful there is a BAT file that can be executed. The file *test.bat* is located in c:\osgVortex (or any other path where you previously installed osgVortex).

```
DOS> test.bat
```

If the installation were successful a window with some 3D graphics will be displayed looking something like this:

If not, then the problem is most probably the settings of the environment variables.

Performance

The performance of your computer is very important to osgVortex. If the performance is to low, the simulation will run in slowmotion, creating unrealistic environments.

By running the sample application test.bat the performance can be measured by pressing the key 'p' on the keyboard. In the top left corner a number will be displayed. This number indicates the frame-rate of the graphics. The frame-rate is 1/frequency of the updates of the graphical window. This can be strongly influenced by a number of things: performance of the graphics card, number of objects in the scene, size of the window, complexity of objects in the scene and last but not least, if the graphics adapter is set to synchronization or not.

Under windows this will at least give a hint of the performance of the computer. On a fast machine it should be equal to or larger than the frequency of the display (usually 75-85Hz) the slower the machine is the lower the frame-rate will be. If the frame-rate is lower than 15 hz, the machine is close to be to slow for osgVortex.

The viewer

The application osgVortex is called a *viewer*, it will parse the script file you specify on the command line as an argument, when the parsing is successfully done, it will create a window and display the simulation environment.

Some important aspects are:

Scene – The graphical object that the simulation contains and can be seen in.

Viewpoint – The virtual camera that looks into the graphical scene. The viewpoint can be manipulated using the mouse.

Origo – The position of the scene that has the coordinates [0,0,0].

Key bindings

To control the viewer there are a lot of key bindings, i.e. actions connected to the keyboard. The most important are:

Key	*Functionality*
space	*Reset the position of the viewer (viewpoint)*
esc	*Quit the program*
r	*Reset the physical simulation*
p	*Print graphics statistics*
*	*Print physics statistics*
t	*Toggle texturing mode on/off*
w	*Toggle Wireframe/Solid/Point rendering mode*
l	*Toggle light on/off*

Navigating in the window

The viewpoint manipulated using the mouse.

Left mouse is used for rotating the camera around origo in a mode called spaceball mode.

Right mouse is used for moving the camera forward/backward.

Middle mouse is used for pan up/down/left/right

Run the test.bat and try to navigate around in the scene.

Now when osgVortex is installed and the installation is verified, we are ready to write our own scripts.

Chapter 3

System description

This chapter will describe the OsgVortex system.

OsgVortex can be said to exist on two different levels: there is a Object oriented API (Application Programming Interface) written in C++ and a *Parser*. The parser is responsible to translate the OsgVortex scripts into calls in the OsgVortex API. So there is two ways of creating a simulation: either by writing a script or writing it directly using the C++ classes, or for that matter, both. A simulation can contain the following items:

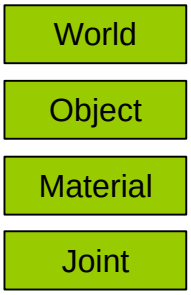


Figure 1: Available items.

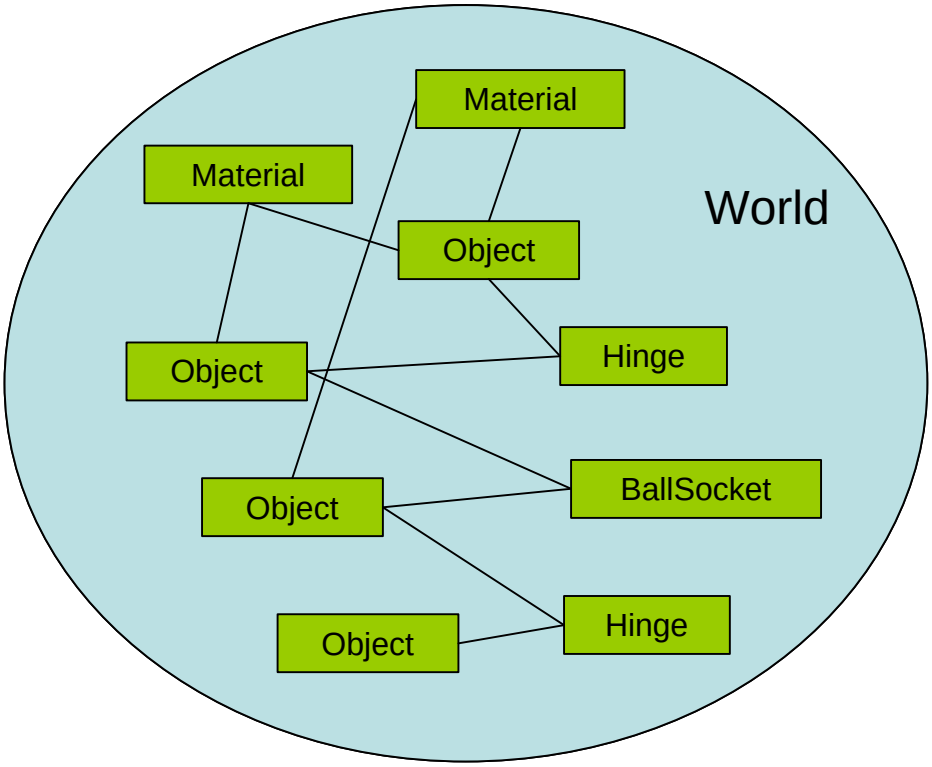


Figure 2: A sample simulation world.

A simulation world is created by specifying one or more of these items in an OsgVortex script file. A *parser* will parse the script and use the appropriate C++ classes to build the world. When the world is created a *simulation engine* takes over and simulates the system.

.

Chapter 4

OsgVortex scripts

This chapter will describe the file format used for creating OsgVortex simulations.

Scripts in OsgVortex are used for creating virtual environments containing visual as well as physical objects. The specifications are object oriented in its syntax. All entries in a script file are called *items*. An *item* is consisting of two things: a *key* and *data*: `<Key> <Data>`

Valid keys must only contain alphanumeric characters and underscore '_'.

Valid keys:

```
a_string
_another_key3
343
```

Invalid keys:

```
A string
:-)
a-value
```

The type of the key is derived from the type of the data.

Example of data	Derived type
1 2334	INT
1.0 1E10 0.234	FLOAT
"a string"	STRING
[2 34.3 4]	FLOAT VECTOR
{ member 45}	STRUCT (containing one INT member)

A *STRUCT* is a recursive datatype which can contain *STRUCTS*. The *key* is case-sensitive, so AnInt and Anint are treated as two separate variables.

An example of a defition is:

```
Object {
  Name "a namestring"
  VisualAttributes  {
    Primitive "box"
  }
}
```

The above example is a struct containing two members, Name (which is a string) and VisualAttributes (wich in self is a struct containing one member, Primitive which is a string).

Comments can be inserted into a script by using the // comment string. Everything after a // on a line is discarded by the script parser, unless it is inside a string. So string_val "//" is allowed.

Example of comments are:

```
Object { // An object will be created
  // The name of the object will be sven
  Name "sven"
} // End of struct
```

Preprocessor

To simplify development of simulations a few preprocessor directives has been added.

Name	Description	Example
#**define** *macro-name value*	Declares a macro, a text string (*macro-name*) that upon found in a script will be replaced with *value*.	`#define HYP sqrt(a*a+b*b+c*c)`

#**ifdef** *macro-name*
#**else**
#**endif**
	If the macro *macro-name* is defined, the code between this #ifdef and the following #else or #endif will be parsed. #ifdef can also be nested.	`#ifdef HYP`
		`  value 10`
		`  #ifdef URK`
		`  value 34.54`
		`  #endif`
		`#else`
		`  value 20`
		`#endif`

Table 1 Preprocessor directives.

Mathematical Expressions

Mathematical expressions are allowed in an OsgVortex script. Table 2 lists all the predefined mathematical functions that exist. The notation of expressions are standard using paranthesis:

```
avalue 34.4*(sin(3)/randInterval(0,1)*exp(3.4))
```

Name	Description	Example
sin, cos, tan, asin, acos, atan, sinh, cosh, tanh		sin(3.4) sinh(0.3)
exp(x), log(x), log10(x) ,sqrt(x), floor(x) ,ceil(x) ,fabs(x), hypot	Cosinus	cos(3.4)
deg(x), rad(x)	Conversion between degrees and radians.	tan(0.3)
randInterval(low, high)	Random number generator. Generates a floating point random number in the interval *low* to *high*	randInterval(0, 1)

Table 2 Predefined functions.

Constants

There are currently two constants defined in OsgVortex. These two constants can be used in expressions.

Name	Description
pi	The value of PI (3.14159265358979323846)
e	The natural constant e (2.71828182845904523536).

Table 3Predefined constants.

Tips how to format files

Indentation of struct members like in the above example are a clever way of making scripts more readable.

```
Astruct {
astructmember 3
substruct {
astructmember
}
}
```

A more readable example:

```
Astruct {
  astructmember 3
  substruct {
    astructmember
  }
}
```

File format of OsgVortex

Some keys are required and some have default values. In the detailed description of each key this will be pointed out.

The keys that OsgVortex currently recognizes are:

Key	Type	Required?	Description
Object	STRUCT	No	Creates an Object, it can be visual or physical or both.
Material	STRUCT	No	Creates a physical material. It defines the contact between two objects.
Viewer	STRUCT	No	Viewer specifications.
World	STRUCT	No	Specifies attributes that is needed to create a physical simulation world.
Joint	STRUCT	No	Creates a joint. Only physical right now.

The tables below describing the different keys have the following structure: every key is defined as:

Name of key	Type	Default value	Range	Description

If a key doesn't have a default value, i.e. it is required, this is indicated with *none*. If a key is a STRUCT then the key is printed in **bold** and will have its own table below.

The order in which the keys are specified is not important at all. Use common sense to arrange the file in the way that makes most sense to you.

World

World sets some global attributes for the whole physical simulation world. It can be to choose from different solvers, friction models etc…

Name	Type	Default	Range	Description
StepLength	FLOAT	0.01	0…	Defines the simulation step length.
Gravity	FLOAT VECTOR	[0 0 9.81]		Specifies the gravity in the simulation.
AutoDisable	INT	0	0/1	Specifies whether objects should be taken out of the dynamic simulation when they are assumed to be standing still, and later on be activated during a collision event.
SafeTime	INT	1	0/1	
Gamma	FLOAT	8xStepLength	0…	If gamma = 0, no relaxation is done at all, and joints will drift apart as the simulation progresses. If gamma is large, a large correction is applied which attempts to zero the constraint violation. The product of gamma*h, where h is the time step, is preferably less than 0.5, and certainly less than 1.0. For most simulations a value of gamma in the range 0.1 through 0.8 will work well. The simulation may become unstable if gamma is chosen poorly. If the time step is varied frequently, the product of gamma*h should be held constant, by resetting gamma when the time step changes. Gamma is more sensitive to time step variation than epsilon.
Epsilon	FLOAT		0…	Epsilon has units of time squared over mass. You should think of 1/epsilon as roughly equivalent to a spring constant. If you know that your system has no singularity, you can let epsilon be as near 0 as you

				like. If you use a lot of really heavy masses, you should decrease epsilon from its default value. If you use a very small time step, you should consider using a much smaller epsilon.
LCPSettings	STRUCT			Contains settings for the LCP solver

Members of World.LCPSettings

Name	Type	Default	Range	Description
MaxIterations	INT	40	0…	Maximum number of iterations used by LCP solver. This defaults to 10 and should only be changed if you have found problems with the defaults. If you set this too high, your applications could slow down in some cases when there are jamming situations with very many contacts with friction.
MaxBlockIterations	INT	20	0…	The LCP solver works using the faster block iterations by default. This can fail however so we force a cieling on the number of lock iterations. By default, we use 10 i.e., the same as the max number of iterations. Do not change this unless you are certain you understand what it does
Tolerance	FLOAT	0.0001	0…	The LCP solver works using the faster block iterations by default. This can fail however so we force a cieling on the number of block iterations. By default, we use 10 i.e., the same as the max number of iterations. Do not change this unless you are certain you understand what it does
DegenerancyFilter	FLOAT	0.0001	0…	This sets up a filter to ignore degenerate constraint. The number should be of the order of 1. The default is 3. Avery large number will make all contacts very spongy. A very small number can produce inefficient results

Example:

```
World {
  StepLength 0.01
  Gravity [0 0 -9.81] // Gravity constant

  LCPSettings {
    MaxIterations 40
    MaxBlockIterations  20
    Tolerance  0.0001
    DegeneracyFilter 0.0001
  }
}
```

Material

Material is a specification of the contact parameters when two objects collide. It may sound strange to create one material for what happens when two objects collides, but a collision between one object is not very useful now is it? Sounds like the sound of one hand clap…

Name	Type	Default	Range	Description
ID	`STRING`	*`required`*		Specifies a unique identification of this material.
Tuple	`FLOAT VECTOR`	*`required`*		Actually one osgVortex Material creates two Vortex materials. This TUPLE indicates the index of these two materials. When an object is created later on, the Material key in Object refers to this TUPLE.
Friction	`FLOAT`	*`required`*		Friction coefficient. 0-100
Restitution	`FLOAT`	*`required`*		Specifies how much energy is kept after a collision. 1 – all energy is kept, 0 none.
RestitutionThreshold	`FLOAT`			
Softness	`FLOAT`			
PrimarySlide	`FLOAT`			
SecondarySlide	`FLOAT`			
PrimarySlip	`FLOAT`			

SecondarySlip	FLOAT			
AdhesiveForce	FLOAT		0…	Adhesive force allows for objects that stick together, as if they were glued. It specifies the minimal force needed to separate the two objects.
FrictionModel	STRING	*"Box"*	"Box" "ScaledBox"	Specifies the friction model used when calculating friction between two objects. ScaledBox is a multipass method which could be more costly.

Example:

```
Material {
  ID "Wheel-floor"
  Tuple [1 0]
  Friction 10
  Restitution 0.1
  FrictionModel "ScaledBox"
}
```

Object

Object is the key to the whole simulation. Without objects there would be no simulation. An object can be *Visual (*i.e. have visual properties) and/or *Physical* (have physical properties). A Visual object can be seen in the simulation, a physical object can interact with other physical object in the simulation. This means that an object can be Physical only, i.e. it will appear in the simulation but not visually. This can sometimes come in handy to create object that connects to joints but are not visible.

Name	Type	Default	Range	Description
ID	STRING	*required*		Specifies an unique identification of this material.
Dynamic	INT	*required*	0/1	Specifies whether this is a static or a dynamic object.
Size	FLOAT VECTOR	*required*		Specifies the size of the object. This can be an array of different sizes depending on the primitive used later.
Orientation	FLOAT VECTOR	[0 0 0]		Rotation around X, Y, Z in Euler angles, right handed coordinate system.

Position	FLOAT VECTOR	[0 0 0]		Specifies the position in world coordinates
PhysicalAttributes	STRUCT			Specifies the physical attributes of an object
VisualAttributes	STRUCT			Specifies the visual attributes of an object.
CopyOp	STRUCT			Specifies how many copies of this object that will be created and how they will be placed.

Members of Object.PhysicalAttributes

Name	Type	Default	Range	Description
Enabled	INT	*1*	0/1	Specifies if this object should be enabled in the simulation or not?
Density	FLOAT	*required*	0…	Specifies the density of the object. The Mass is calculated from the primitive. This ONLY works for primitives. Density cannot be specified together with Mass.
Mass	FLOAT	*required*	0…	Specifies the mass of the object. Cannot be specified at the same time as Density.
AngularDamping	FLOAT		0.001	Specifies the rotational damping, sort of the internal resistance to rotational acceleration.
LinearDamping				Specifies the linear damping, the resistance linear acceleration.
Material	INT	*MdtDefaultMaterial()*	0…	Specifies the material index for this object. This must be an integer specified in the Tuple key of a **Material**.
AngularVelocity	FLOAT VECTOR	*[0 0 0]*		Specifies the rotational
LinearVelocity		*[0 0 0]*		
MomentOfInertia		*[0.4 0 0 0 0.4 0 0 0 0.4]*		Specifies the Moment of Inertia Tensor.
Geometry	STRUCT			Specifies the collision geometry of this Physical object. If no geometry is specified, no collisions with this object is possible.

Members of Object.PhysicalAttributes.Geometry

Name	Type	Default	Range	Description
Primitive	`STRING`		`sphere ,box, cone, cylind er`	Specifies the primitive that represents the object physically (collision). This also specifies the length of the size vector.
File				Not implemented yet.
ParseMethod				Not implemented yet.

Members of Object.VisualAttributes

Name	Type	Default	Range	Description
Geometry	STRUCT			Specifies the geometry of this Visual object.
Light	`STRUCT`			Specifies that this Visual Object also has a light source attached to it.

Members of Object.VisualAttributes.Geometry

Name	Type	Default	Range	Description
Primitive	`STRING`		`sphere ,box, cone, cylind er`	Specifies the primitive that represents the object visually. This also specifies the length of the size vector. This key conflicts with File and cannot be specified at the same time.
File				Specifies the filename of an 3D object that should be loaded for this object. This key conflicts with Primitive and cannot be specified at the same time.
Scale	`FLOAT VECTOR`	*`[1 1 1]`*		Specifies how much the loaded File should be scaled. (Only valid when File is specified).
Optimize	`INT`	*`0`*	`0/1`	Specifies if Optimization of the Visual part of the object

				should be performed. For larger object this can improve performance.

Members of Object.Light

Name	Type	*Default*	Range	Description
Ambient	FLOAT VECTOR			Specifies a 4 dimensional array of Red., Green, Blue, Alpha intensity for ambient light.
Diffuse	FLOAT VECTOR			Specifies a 4 dimensional array of Red., Green, Blue, Alpha intensity for diffuse light.
Specular	FLOAT VECTOR			Specifies a 4 dimensional array of Red., Green, Blue, Alpha intensity for specular light.
SpotCutOff	FLOAT			
SpotExponent	FLOAT			
QuadraticAttenuation	FLOAT			
LinearAttenuation	FLOAT			
ConstantAttenuation	FLOAT			

Example 1: Visual object

```
A minimum visual Object:
Object {
  ID “unique obj id”
  Dynamic 0  // non-moving
  Size [0.4] // size
  VisualAttributes {  // Can be seen in the simulation
    Geometry {
      Primitive “sphere”  // Is a sphere (with radius 0.4)
    }
  }
}
```

Example 1 will create a visual non-moving sphere with a radius of 0.4 at position [0 0 0] with no rotation applied.

Example 2: Physical object

```
Object {
  ID “physical invisible”
  Size [1 1 1]
  Position [0 -1 0.5]
  Dynamic 0
  PhysicalAttributes {
       Geometry {
         Primitive “box”
       }
  }
}
```

Example 2 will create a physical-only non-moving cube with sides 1, 1, 1 at position [0 -1 0.5] with no rotation applied. This object will not show up in the simulation visually, but it will exist as an physical object that other object can collide with.

Example 3: Visible and Physical object

```
Object {
  ID “fully dynamic object”
  Size [0.5 1]
  Position [2 -3 4]
  Orientation [45 0 0]
  Dynamic 1
  PhysicalAttributes {
    Mass 1
    Geometry {
      Primitive “cylinder”
    }
  }
  VisualAttributes {
    Geometry {
      Primitive “cylinder”
    }
  }
}
```

Example 3 will create a visible cylinder that is also represented in the physical simulation. It will start at position [2 -3 4] and will be rotated 45 degrees around X. It has a mass of 1.

Example 4: Initial state

```
Object {
  ID “moving object”
  Size [0.1 1]
  Position [2 -3 4]
  Orientation [0 0 0]
  Dynamic 1
  PhysicalAttributes {
    Mass 1
    Geometry {
      Primitive “cylinder”
```

```
    }
    AngularVelocity [0 1.2 3]
    LinearVelocity [2 -3 4]
    LinearDamping 0.1
    AngularDamping 0.1
    MomentOfInertia [0.3 0 0 0 0.3 0 0 0 0.3]
  }
  VisualAttributes {
    Geometry {
      Primitive “cylinder”
    }
  }
}
```

Example 4 creates an object that has an initial velocity, both rotational and linear. It also sets the Moment of Inertia tensor.

Joint

A joint is a constraint that connects two objects with each other. There are several joints and they all have different features.

Name	Type	*Default*	Range	Description
ID	STRING			Specifies a unique identification.
Object1	STRUCT	*required*		
Object2	STRUCT	*required*		
Enabled	INT	*1*		Determines if the joint should be enabled or not.
Position	FLOAT VECTOR	[0 0 0]		Specifies the position of the joint.
Axis	FLOAT VECTOR			Specifies the rotation axis of the hinge.
UpperLimit	FLOAT			Specifies the upper stop limit for a joint.
LowerLimit	FLOAT			Specifies the lower stop limit for a joint.
UpperStiffness	FLOAT			Stiffness of the Upperlimit.
LowerStiffness	FLOAT			Stiffness of the LowerLimit
UpperDamping	FLOAT			Specifies the damping of the UpperLimit

LowerDamping	FLOAT			Specifies the damping of the LowerLimit
DesiredVelocity	FLOAT			Specifies the desired velocity of this joint.
MaxForce	FLOAT			Specifies the maximum force the motor can operate with on this joint to reach the DesiredVelocity.
BallSocket	STRUCT			Creates a BallSocket joint
Hinge	STRUCT			Creates a Hinge joint
Linear1	STRUCT			Creates a Linear1 joint
CarWheelJoint	STRUCT			Creates a CarWheel joint.

Members of Joint.Objec1t

Name	Type	*Default*	Range	Description
ID				ID of the object that we want to attach to this joint
Position				Attachment position of this object to the joint

Members of Joint.Object2

Name	Type	*Default*	Range	Description
ID				ID of the object that we want to attach to this joint
Position				Attachment position of this object to the joint

Members of Joint.BallSocket

Name	Type	*Default*	Range	Description

Members of Joint.Hinge

Name	Type	*Default*	Range	Description

Example 1:

```
Joint {
  ID "hinge2"
  Hinge {}              // this is a hinge
  Axis [0 0 1]
  Position [1.1 0 1]
  Object1 {
    ID "door2"    // 1st object that is attached
  }
  Object2 {
   ID "wall2"     // 2nd object.
  }
  Enabled 1             // It is enabled by default
  UpperDamping 300
  LowerDamping 0
  MaxForce 10           // Maximum force to achieve DesiredVelocity
  DesiredVelocity -5
  UpperLimit 10
  LowerLimit 0
}
```

Chapter

5

What if it goes wrong?

This chapter will describe the warning and error messages and what to do if the simulation doesn't work the way you want.

This could easily be the largest chapter in the whole manual. Unfortunately it is impossible to predict everything that can go wrong. There are many sources for mistakes. OsgVortex will try to inform the user of its current status. If something goes wrong the user should be informed.

There are three different levels of messages: Errors, Warning and Info.

Errors and warnings that osgVortex will print out is important. Some of them is critical (Error) some are not critical but should not be ignored (Warning). There are also information messages (Info)

Known bugs

- Expressions such as:

```
Astruct {
  sub1 {
    value 2
   }
   sub2 {
     x sub1.value // sub1.value is not known here.
   }
}
```

Where a substructure is trying to access a siblings member variable is not currently allowed (will be soon though).

- Reset does not mimic a total restart of the simulation (that is the system is not really put back to its initial state).

- More?